Is it Paying?

When the Fall River mule spinners struck work in the face of conditions which made the failure of the strike highly probable, to say the least, the question was raised, "Will it pay?"

The circumstance that the mill owners were able to fill the places of most of the strikers without much delay, leaving the strikers permanently out in the cold, strongly indicated that the answer to our question would have to be in the negative. Its probability is heightened by press reports to the effect that at a meeting of the directors of one of the mills, August 5, it was voted to discontinue the use of about ten thousand mule spindles—about one-fourth of the whole number used in the mill—and to substitute ring frame spindles therefor.

Correspondence.

The New Optical Delusion.

To the Editor of the Scientific American:

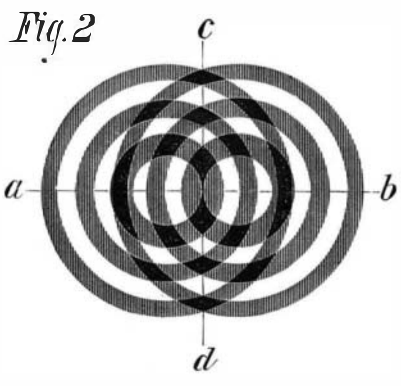
In your last issue you illustrate two optical puzzles. The explanation given below shows clearly, I think, that the phenomena depend on the property of the retina to retain images of objects for a certain interval after the latter are removed. Fig. 1, whilst being steadily gazed at, is to be moved in a small circle without being rotated; in other words, the

Fig. 1

figure is to be moved in the same way that one moves a pail in rinsing it out. The rings will then appear to be rotating about their center in the same direction that one is moving the figure. The center of the circle in Fig. 1 is moved on the line of the dotted circle in the direction shown by the arrow. Suppose, for the sake of explanation, that impressions made on the retina are erased every $\frac{1}{8}$ of a second, and that you move the figure so that its center, *x*, completes the dotted circle once per second.

An impression of the rings is made on the eye; the rings are then moved so that their center completes an arc of, say, $\frac{1}{16}$ of the dotted circle; a second impression is made on the eye; the first impression is not yet erased, as only $\frac{1}{16}$ of a second of time has passed since it was formed, so that the retina has the two images superimposed, as shown in Fig. 2. In this figure the most white space is shown on the line, *a b*, and most black space along *c d*; the rings are moved another arc of $\frac{1}{16}$ of the dotted circle, and a third impression is made on the retina; $\frac{1}{8}$ of a second has now elapsed since the first impression was made, and, agreeably to our supposition, it is now obliterated; the figure on the retina is now as in Fig. 3.

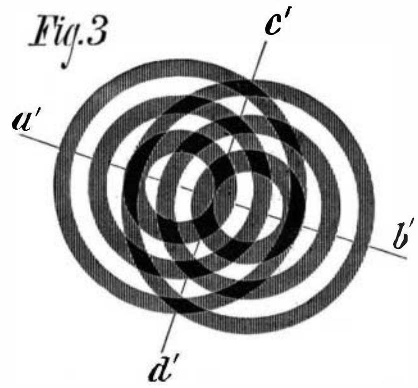
Fig. 2



The line of white parts, let it be observed, has moved from its horizontal position, *a b*, Fig. 2, to the inclined position, *a' b'*, Fig. 3; similarly the line of dark parts has moved from the vertical to the inclining position. The figure is moved another arc of $\frac{1}{16}$; now $\frac{1}{8}$ of a second has elapsed since the second impression was taken, so that it in turn disappears, leaving on the retina the impression like Fig. 4; here the white parts have moved still further from the horizontal, and the dark parts from the vertical position; the two, in fact, are traveling in a circle, and, as will be seen by imagining this series of figures completed to the number of sixteen, the light and shade will complete a circle every time the center of the rings completes one. It is the light and shade moving in a circle that gives the rings the appearance of revolving. Of course if the rings in the figures overlap each other more or less, or, in other words, if the rings are moved in a larger or smaller circle, the configurations sent to the eye are quite different, but in all of them the lights and shadows are following each other around the circle, and always giving the rings the appearance of revolving.

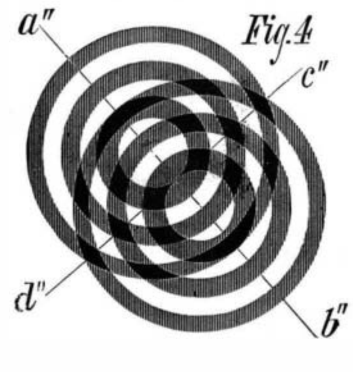
For the cogwheel puzzle, make the same suppositions as for the ring puzzle. An impression of the wheel, Fig. 5, is made on the retina; the wheel is moved an arc of $\frac{1}{16}$ of the dotted circle. when a second impression is made; the first impression still remains, and the eye sees an object like Fig. 6. The actual wheel is represented by the right hand one of the two superimposed figures, the left hand figure representing the first impression. The first impression is, of

Fig. 3



course, not so strong as the last, and therefore the cogs at *b*, part of the first impression, are not seen with anything like the distinctness of the cogs, *a*, parts of the actual wheel. The cogs at the right hand side of the right hand wheel (the actual wheel) are not seen as distinctly as those on the left hand side, because they project into a black space; that is, the rays of light coming from these cogs to the eye fall on

Fig. 4



a part of the retina that is occupied by the, as yet unerased, first impression. These cogs, therefore, although on the actual wheel, are vaguely seen; the only cogs seen distinctly, therefore, are those at the left hand side of right hand wheel, at *a*. While the cogs, *a*, are clearly seen, the center of the wheel is moved $\frac{1}{16}$ of the way round the dotted circle in the direction of arrow.

The wheel is thus moved in a downward direction; the cogs, *a*, the only parts distinctly seen, are moved downward.

Fig. 5.

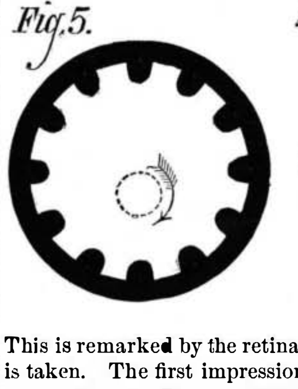
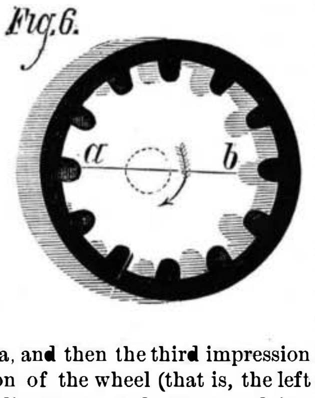


Fig. 6.



This is remarked by the retina, and then the third impression is taken. The first impression of the wheel (that is, the left hand wheel of Fig. 6) now disappears, and the second impression (that is, the right hand wheel of Fig. 6) becomes pale. By the same reasoning employed with Fig. 6, we find that the only cogs seen distinctly in Fig. 7 are those at *a'*, and that they move in the same direction that cogs, *a*, in Fig. 6, do. Fig. 8 shows a further stage in the reasoning process,

Fig. 7

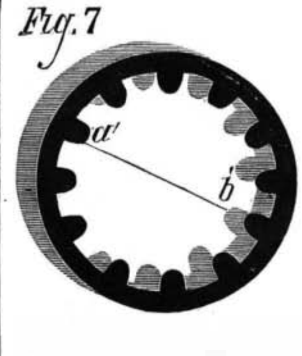
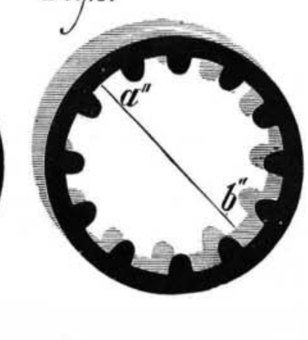


Fig. 8.



the prominent cogs being at *a''*, moving also in the same direction as those at *a* in Fig. 6. Now, all the cogs when distinctly seen are moving in a direction contrary to the hands of a watch, thus giving the wheel the appearance of revolving in that direction.

The drawings can be better understood by tracing Figs. 1 and 5 on tissue paper, and then moving the tissue paper over the prints in the prescribed way. A. O.

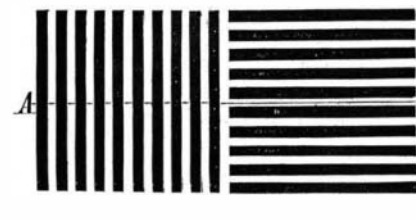
Cincinnati, O., August 3, 1879.

The Optical Delusion—An Explanation.

To the Editor of the Scientific American:

In the last SCIENTIFIC AMERICAN, for the week ending August 9, I saw an article respecting some remarkable optical delusions, and as no explanation has been offered, I should like to state a theory which seems very well to answer the conditions of the question involved.

In Fig. 1 we have two sets of parallel lines, one horizontal, the other perpendicular; if we move the paper backward and forward, along the line, A B, the horizontal lines will remain clear and distinct, while the others will be blurred and indistinct. This principle has been applied in the octagonal figure, in Fig. 2. If the paper is moved to the right and left, the sections, A and E, will be clear, while C and G are dim, because of the lines overlapping each other. If it were possible to move the paper first across G and C, then D and H, E and A, and so on around, A and E would shine out clearly, then B and F, while the sections at right angles to these would be dimmed. In this way two bright sections would be seen to advance from section to section, followed by two dim sections; and if it were not for the sharp angles, which arrest the attention, the whole polygon would seem to revolve. If we increase the number of the sides of the polygon, the angles will be less prominent; and if this process is continued, the polygon will become a circle. When we perform the experiment with the circle we are immediately struck by this shadow, which is seen to cross the circle in the direction of the motion, and when it is whirled around, according to the instructions



given, we can see it very distinctly moving around, and giving the impression that the circle itself is in motion. Another reason suggests the truth of this "shadow theory." If, while the circle is in full motion, the observer throws his eyes out of focus (some have that power), all the rings will become blurred, and the shadow will disappear, causing the circle to stand still. This delusion differs from the other in a very marked degree. In Fig. 6—[as H. W. F.'s Fig. 3 corresponds with A. O.'s Fig. 6, we refer to that figure]—suppose that the paper is moved in the direction of the arrow. As we move it in a curve toward the right, the tooth, *a*, comes into notice; but as the paper retires, in a curve to the left, the tooth is overlapped by the shadow of the ring, which the retina holds. This takes place at each tooth, and the interior of the ring seems to have a retrograde motion. This second delusion is not so easily seen as the first, and I have devised a surer way of seeing it, namely, by making the teeth longer and more numerous, and by filling in the center of the circle with black. In observing this class of phenomena I was much surprised by another curious fact. I was looking at a moving circle, while others on a separate piece of paper lay near me on the table, and, although my

Fig. 2.

attention was concentrated on the moving paper, I could see the other circles going at the same rate of speed. As soon as I looked at a stationary object, the other circles stopped.

I afterward tried the same thing in a different form: I placed the point of my pen near one of the circles, and moved it around, watching it closely all the time. I could then see all the circles spin around, as before.

Stamford, Conn., Aug. 4, 1879. H. W. F.

The Aurora.

Professor Trouvelot states that a beautiful auroral display was observed at Cambridge, on the evening of June 17. It began at about 9:15 P. M., and lasted until 11:45 P. M. The illuminated portion of the sky was nearly 20° E. and 15° W. of the magnetic pole, it extended about 40° vertically to the horizon, being highest in the vicinity of the pole. Many whitish and cream colored streamers were seen, especially to the west of the magnetic meridian, the undulations being well marked and numerous, no rosy-hued streams being observed. Along the horizon and densely massed were dark cumuli clouds, through openings of which could be seen the auroral light, showing distinctly that the effect must have taken place in the atmosphere beyond the clouds in question.